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A Study on Economic Impact in the Context of American Election Based on AHP

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ABSTRACT

To assess the economic impact of the different policies of the Trump and Biden candidates, we formulate metrics on five aspects: Covid-19 prevention and control measures, environmental protection policies, taxation, health care reform, foreign trade. Moreover, each metric is subdivided into several secondary metrics, making a three-tier hierarchical structure. Take environmental protection policy as an example: Without direct data under Biden's policies, we collected data on U.S. CO_2 emissions and U.S. oil consumption during Obama's presidency as Biden's legacy. First, use the analytic hierarchy process (AHP) to select indicators that can reflect the U.S. economy and determine the weight of each indicator. For the U.S. economy, Biden scored 2.6498, Trump 2.3502, suggesting that the election of Biden might make things better for the economy. For China's economy, Biden scored 0.6810 and Trump 0.3245, meaning Biden could give the Chinese economy more room to grow. To reduce the influence of AHP subjectivity on the results, the Pearson correlation coefficient is introduced to establish the P-AHP model. Take the impact on China's economy. Biden scored 0.5846 and Trump 0.4154.

1. Introduction

The race for the 59th U.S. presidential election in 2020 will undoubtedly be the one between former vice president Joe Biden, the Democratic nominee, and current President Donald Trump, the Republican nominee. The two candidates have different political positions and policy platforms in the fields of finance, epidemic prevention, and medical care. Different policies are bound to have different impacts on the United States and China respectively. To evaluate the relative merits of the two presidents, this paper uses relevant data to consider and quantify their behaviors in different fields.

Analyzing the impact of different candidates on the economy is an evaluation question and there are models to

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solve such problems.

One is the Analytic Hierarchy Process (AHP). It is a decision-making method to decompose the elements related to decision-making into goals, criteria, schemes, and other levels, and then conduct qualitative and quantitative analysis on this basis. This method is a hierarchical weight decision analysis method proposed by American operations research scientist Sati.

2. The Impact on U.S.'s Economy

2.1 Problem Analysis and Preparation

Different leaders have different policies to govern and different policies to treat different areas of development. Across many different development areas, we selected five areas to evaluate the two candidates: COVID-19 prevention and control measures, environmental protection policies, tax, health care reform, and foreign trade.

2.1.1 COVID-19 Prevention and Control Measures

With more than 10 million confirmed cases and nearly 270,000 deaths, the United States is now at the center of the global COVID-19 pandemic, so the need for aggressive

U.S. action to contain the spread of COVID-19 is an important indicator for both candidates. The impact of different policies on the economy was analyzed through the daily number of new patients m and the unemployment rate n of the United States [3, 4].

Choose the slope km of the number of new patients per day and the growth rate of employment rate and the unemployment rate to calculate the weight of k_e and K_{un}'s average T-year scores during their respective candidates' term:

$$S_m = \frac{\sum_m K_m}{t}$$

$$S_e = \frac{\sum_e K_e}{t} \quad (1)$$

$$S_{un} = \frac{\sum_{un} K_{un}}{t}$$

2.1.2 Environmental Protection Policies

Countries all over the world are trying their best to achieve better development. As a developed country, the United States is at the forefront of the world in terms of development speed and development level. However, there are serious ecological problems behind the development [5].

The weight of K_{oil} and K_{CO2} was calculated from the production and consumption of oil in the United States and the slope of national CO_2 emissions in term t:

$$S_{oil} = \frac{\sum_{oil} K_{oil}}{t}$$

$$S_{CO_2} = \frac{\sum_{CO_2} K_{CO_2}}{t} \quad (2)$$

2.1.3 Tax

Tax revenue is the most important form and source of government public finance.

The object of tax revenue may change under different policies.

Select the T_H and T_l of the highest and lowest common tax rates in the US, and calculate the weight of the taxable income boundary LH of the highest tax rate in the t- year of the term:

$$T = \frac{\sum_i T_i}{t} \quad i = H、L$$

$$L = \frac{\sum_H L_H}{t} \quad (3)$$

2.1.4 Health Care Reform

The goal of different candidates is to provide the American people with the ideal health insurance. Choose the average life expectancy at birth of The American people in the year T, the IMR of the U.S. infant mortality rate, the slope of personal medical expenditure - net medical insurance PM in the year T. K_{IMR}, K_{PM}:

$$S_{LE} = \frac{\sum_{i=1}^{t} LE}{t}$$

$$S_{IMR} = \frac{\sum_t K_{IMR}}{t} \quad (4)$$

$$S_{PM} = \frac{\sum_t K_{PM}}{t}$$

2.1.5 Foreign Trade

Foreign trade is an important part of the GDP of many countries. The slope of MTE in the term t of the export value of us goods trade is selected to calculate the weight of KMTE. Select the slope of MTE in the term t of the export amount of US goods trade [6]. K_{MTE} is used to calculate the weight:

$$S_{MTE} = \frac{\sum_i MTE_i}{t} \quad (5)$$

2.2 Collect Data

2.2.1 Covid-19 Prevention and Control Measures

Biden and Harris delivered their election speech to the nation in Wilmington, Delaware at 8 p.m. Edt. He stated his "healing plan." It says it will advance the free Novel Coronavirus test, establish a national testing program to identify people at risk of infection or infection and force the entire nation to wear face masks. For quantitative analysis, this paper only analyzes the impact of the compulsory wearing of masks on the epidemic in the United States, and the evaluation index is the number of new confirmed cases per day.

To better explain the problem, data from other countries are used to simulate the effect of Biden's policies after he takes office.

Choose South Korea. The reasons are as follows:

1.South Korea is a developed country like the United States;

2.South Korea and the United States are both capitalist countries;

3.South Korea and the United States started at similar times.

In South Korea, masks were mandatory on August 22, 2020, so data collection began on August 22. Due to the differences in basic population and the land area between the two countries, it is meaningless to directly compare the size of data.

Besides, the employment rate and unemployment rate during the epidemic can also reflect the treatment effect of different measures during the epidemic to some extent.

2.2.2 New Energy Policy

Since Biden is not officially in office, we can't find direct data on Biden. So we compare Obama's new energy policy with Biden's policy and find the two are very similar:

① Invest heavily in clean energy research and development, lower taxes on clean energy businesses, and create jobs;

② Invest in new hybrid vehicles, encourage higher energy efficiency, and expand the commercial scale of renewable energy;

③ Promote the renovation of existing buildings, adopt new methods to improve building efficiency, promote the upgrading of facilities, and reduce the energy cost of residential buildings.

So we gathered U.S. CO2 emissions and U.S. oil consumption under Obama as possible outcomes of Biden's policies.

2.2.3 Tax

Due to the differences between Republicans and Democrats in supporters and pursuits, the Republicans are more inclined to reduce the tax rate of relatively affluent people, while the Democrats are more inclined to tax the rich. We choose several indicators to reflect the impact of taxes on the economy.

When we collected data from the Internet, we noticed that some of the data were missing or parts of the site had big errors. Given this fact, we must preprocess the data. We mainly populate the data based on interpolation based on rankings generated by other metrics.

2.2.4 Health Care Reform

In addition to their vastly different tax policies, the two candidates have very different views on health care reform: Trump repealed Obamacare immediately after taking office, while Biden promised to expand it. Here, too, Biden and Obama have similar policies: provide affordable and acceptable health insurance for all, introduce low-cost insurance, and strive to increase coverage. So we still use the Obama-era data to simulate the effect of The Biden policy, and we choose life expectancy at birth, expected national health care spending, and infant mortality to reflect the evaluation of health care.

2.2.5 Foreign Trade

The value of foreign trade, also known as the import and export value of foreign trade, is the amount of trade expressed in currency. It is the total value of a country's import and export commodities in a certain period. Therefore, the export value of commodities can directly reflect the amount of foreign trade and help us evaluate the two candidates. Similarly, different from Trump, Biden continues Obama's foreign trade policy: taking internationalism as the core, emphasizing the responsibility of enterprises to workers, and promoting the return of foreign industries to China. Therefore, here we collect a comparative evaluation of the export amount of goods during Obama's and Trump's periods.

2.3 A Model of Economic Quantitative Analysis

2.3.1 The AHP Hierarchy Layered

2.3.2 Construction of Judging Matrix

We use the pairwise comparison method and the 1-9 method of analytic hierarchy process to construct the judgment matrix.

The judging matrix $A=(a_{ij})_{n*n}$, and satisfies:

Table 1. The three-hierarchy structure of AHP

Target	Criterion	Scheme
The economic impact	Prevention and control measures in COVID-19	●The number of patients is increasing daily ●The employment rate ●The unemployment rate
	Environmental protection policy	●Total Carbon Dioxide Emissions From All Sectors, All Fuels for the United States ●Oil consumption
	Taxation	●Tax Rates for Regular Tax: Highest Bracket ●Tax Rates for Regular Tax: Lowest Bracket Taxable Income Boundary Over which the Highest Tax Rate Bracket ●Applies
	Medical insurance reform	●Life Expectancy at Birth ●Infant Mortality Rate ●Personal consumption expenditures: Net health insurance
	Foreign trade	●Merchandise trade: export value

$$a_{ij} > 0, a_{ji} = \frac{1}{a_{ij}}, a_{ii} = 1 \qquad (6)$$

A_{ij} is assigned as the 1~9 method.

2.3.3 Calculate the Consistency Test of the Weight Vector and the Discriminant Matrix

The discriminant matrix is normalized according to columns:

$$w_i = \frac{v_i}{\sum_{i=1}^{n} v_i} \qquad (7)$$

Find the maximum eigenvalue:

$$\lambda \max = \frac{1}{n} \sum_{i=1}^{n} \frac{(Aw)_i}{wi} \qquad (8)$$

Calculate the consistency index CI:

$$CI = \frac{\lambda \max - n}{n - 2} \qquad (9)$$

The corresponding mean random consistency index RI was determined by looking up the table.

Table 2. RI table if mean random consistency index

Matrix order	1	2	3	4	5	6	7	8
9RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41

Calculate the consistency ratio (CR) and make a judgment:

$$CR = \frac{CI}{RI} \qquad (10)$$

Finally, the possible impacts of different candidates on the economy will be calculated by quantifying the weights of all indicators, and then the scores of different candidates Si:

$$S_i = \sum_{i=1}^{5} CW_i \sum_{j=1}^{wi} AW_j \cdot F_j \qquad (11)$$

Where CW_i is the criterion layer weight matrix, AW_j is the scheme layer weight matrix, and F_j is the normalized original data.

2.4 Results and Analysis

The judgment matrix is obtained by comparing the degree of importance:

$$A = \begin{bmatrix} 1 & 5 & 5 & \frac{1}{3} & \frac{1}{9} \\ \frac{1}{5} & 1 & 1 & \frac{1}{7} & \frac{1}{7} \\ \frac{1}{5} & 1 & 1 & \frac{1}{5} & \frac{1}{7} \\ 3 & 7 & 5 & 1 & \frac{1}{3} \\ 9 & 7 & 7 & 3 & 1 \end{bmatrix} \qquad (12)$$

Standard weight vector:
CW=[0.1263,0.0408,0.0433,0.2395,0.5500]
CI=0.1112、CR=0.0993 .Satisfy Consistency standard of CI/RI<0.1.

Scheme layer weight vector:

Epidemic prevention measures in COVID-19 $AW_1=[0.7143, 0.1429, 0.1429]$

The environmental protection $AW_2=[0.75, 0.25]$

Medical insurance $AW_3=[0.0810, 0.1884, 0.7306]$

Tax $AW_4=[0.0909, 0.4545, 0.4545]$

The foreign trade $AW_5=[1]$

And all scheme layers meet the consistency standard of CI/CR<0.1.

Finally, the scores and total scores of different candidates in various fields are obtained:

Table 3. Final score

Criterion layer weight	Scheme (Weight)	Biden	Trump
	PCC1(0.7145)	0.896	0.104
0.1263	PCC2(0.1429)	0.248	0.751
	PCC3(0.1429)	0.290	0.709
0.0408	EPP1(0.75)	0.532	0.467
	EPP2(0.25)	0.488	0.511
	T1(0.4545)	0.516	0.483
0.0433	T2(0.0909)	0.5	0.5
	T3(0.4545)	0.448	0.551
	MIR1(0.081)	0.500	0.499
0.2395	MIR2(0.1884)	0.666	0.333
	MIR3(0.7306)	0.354	0.645
0.5500	FT1(1)	0.502	0.497
	Score	2.6498	2.3502

Depending on the score, of the two candidates, Biden's victory could be better for the economy.

3. The Impact on China's Economy

3.1 Collect Data

To reflect the impact of relevant US policies on China's economy, data from five aspects are collected and explained here. That is China's greenhouse gas emissions, the volume of US exports to China, the total value of US imports from China, the total value of China's imports and exports, and the total value of US imports and exports.

3.2 A Model of Economic Quantitative Analysis

The secondary hierarchy containing the target layer and the criteria layer is shown in Table.

Table 4. The two-hierarchy structure of AHP

Target	Criterion
The economic impact	●China's greenhouse gas emissions(CGG)
	●The volume of U.S. exports to China(VEC)
	●The total value of U.S.imports from China customs(TUC)
	●Total import and export value of China(TC)
	●Total VALUE of U.S.imports and exports(TU)

3.3 Result and Analysis

Obtain judgment matrix:

$$A = \begin{bmatrix} 1 & 5 & 5 & 9 & 1 \\ \frac{1}{5} & 1 & 1 & 5 & \frac{1}{7} \\ \frac{1}{9} & \frac{1}{5} & \frac{1}{5} & 1 & \frac{1}{7} \\ 3 & 7 & 5 & 1 & \frac{1}{3} \\ 9 & 7 & 7 & 3 & 1 \end{bmatrix} \tag{13}$$

Standard horizontal weight vector:

CW=[0.3687 0.0883 0.0883 0.0371 0.4232]

CI=0.0788, CR=0.0704.Satisfy Consistency standard of CI/RI<0.1.

Table 6. Final score

Criterion layer	Biden	Trump
CGG(0.3687)	0.75569	0.24430
VEC(0.0883)	0.26099	0.73901
TUC(0.0883)	0.97028	0.02971
TC(0.0371)	0.85355	0.14644
TU(0.4232)	0.61918	0.38081
Score	0.68104	0.32454

Depending on the score, a Biden vote could have a better impact on China's economy.

Table 7. Relevance[b]

	year	Domestic greenhouse gas emissions	Total import and export volume of China	Total US imports and exports	Us exports to China	The US imports from China	China's GDP
Year	1	.962	.917	.947[**]	.890[**]	.921[**]	.994[**]
Domestic greenhouse gas emissions	.962	1	.836	.868[**]	.833[**]	.803[**]	.979[**]
Total import and export volume of China	.917	.836	1	.979[**]	.794[**]	.942[**]	.893[**]
Total US imports and exports	.947	.868	.979	1	.871[**]	.971[**]	.930[**]
Us exports to China	.890	.833	.794	.871[**]	1	.876[**]	.882[**]
The US imports from China	.921	.803	.942[**]	.971[**]	.876[**]	1	.898[**]
China's GDP	.994	.979	.893[**]	.930[**]	.882[**]	.898[**]	1

4. Model Refinement

The AHP is too subjective in the construction of contrast matrix, which mainly relies on the experience and preference of decision-makers, and is not objective enough.

Given this, the Pearson correlation coefficient is used to quantitatively find the relative importance of elements. In other words, the Pearson correlation coefficient is used to construct the Judging matrix. The following table is obtained after Pearson correlation analysis using SPSS25 for the elements involved in the second question.

According to Table 7 column 7, the relative importance of the elements mentioned in the previous article can be obtained, and a comparison matrix can be constructed based on this. The comparison matrix is as follows:

$$A' = \begin{pmatrix} 1 & 1.0963 & 1.0527 & 1.1100 & 1.0902 \\ 0.9122 & 1 & 0.9570 & 1.0125 & 0.9944 \\ 0.9499 & 1.0414 & 1 & 1.0544 & 1.0356 \\ 0.9009 & 0.9877 & 0.9484 & 1 & 0.9822 \\ 0.9173 & 1.0056 & 0.9656 & 1.0181 & 1 \end{pmatrix}$$

(14)

After calculation, the corresponding standard weight vector is obtained:

CW=[0.2137 0.1948 0.2030 0.1925 0.1960]

CI=1.6800e-4, CR=1.5000e-4. Satisfy Consistency standard of CI/RI<0.1.

The score in Table 8 can be obtained by using the calculation method above.

Table 8. Final score

Criterion layer	Biden	Trump
CGG	0.2443	0.7557
VEC	0.8536	0.1464
TUC	0.6192	0.3808
TC	0.2610	0.7930
TU	0.9703	0.0297
Score	0.5846	0.4154

The results are both Biden, and the P-AHP advantages will be indicated in the model test.

5. Conclusions and Prospects

The political parties of the two presidential candidates both hold their political ideas. Under the background of the epidemic, different political ideas give rise to different policies, which in turn have an impact on countries around the world. This paper can provide a positive reference for China's policy under the current world situation.

By combining AHP and Pearson coefficient, we can further show that Trump does better than Biden in CGG and TC, but Biden generally does better than Trump in other aspects. Given the current state of affairs between the US and China, we can conclude that the US and China will be better off in every way under a Biden administration than under a Trump administration.

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